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BRIEFER ARTICLES.

DEFORESTATION AND CREEK FLOW ABOUT MONROE, WISCONSIN.¹

(WITH A MAP)

ON a large scale and in a rather hazy way the drying up of lands whose forests are removed is a matter of history and is popularly accepted as a fact. In detail and near at hand, however, there is still some scarcity of available evidence. This note and the accompanying map show, as far as a map can, the changes in the surface flow of water which have accompanied the gradual removal of the native forest from four townships of Green county, Wisconsin.

The tract is typical of the surrounding region. To the south there is more native prairie and the forest has been more completely removed, while to the north and west a rather larger trace of the primeval forest survives. Including the neighboring towns on the east and north would not have altered the complexion of the map at all.

The land in these towns is almost wholly tillable. Underlying most of it is limestone (Galena), with a coat of clay under the fertile surface of soil; the Pecatonica River and some of the larger creeks cut through into the St. Peter sandstone. The limestone shows on the brow of a few hills and low sandstone cliffs border the valleys of the creeks in a very few places. Practically all the land can be plowed, and all of it makes valuable pasture.

The settlement of these towns began about the time of the Black Hawk War, and a number of the earliest settlers are still living. They located along the edge of the timber, and the prairie towns preceded those forested in settlement. The population increased rapidly after 1840, and by 1860 was practically what it is now. The first great use of the land was grain-growing, which has declined since the Civil War. What lumbering industry there was has disappeared with the material for it. The dairying interest has steadily grown, very rapidly during

¹The most of the work embodied in this paper was done by Mr. Shriner and myself during the summer of 1902. After I left Monroe Mr. Shriner filled in the areas on the map where reliable information had not been obtained at the first attempt, and also prepared the map.—E. B. C.

the last twenty years, until Green is the greatest cheese-producing county in the country.

The expansion of the cheese interest made it possible for a limited rural population to get large returns from a much greater area of hilly country than it could till, and has certainly been a large cause of the final clearing of the land. At the same time the demands of the neighboring cities have advanced the price of fuel, and three lines of railroad in these four towns built during the eighties gave all parts of them a short haul to market.

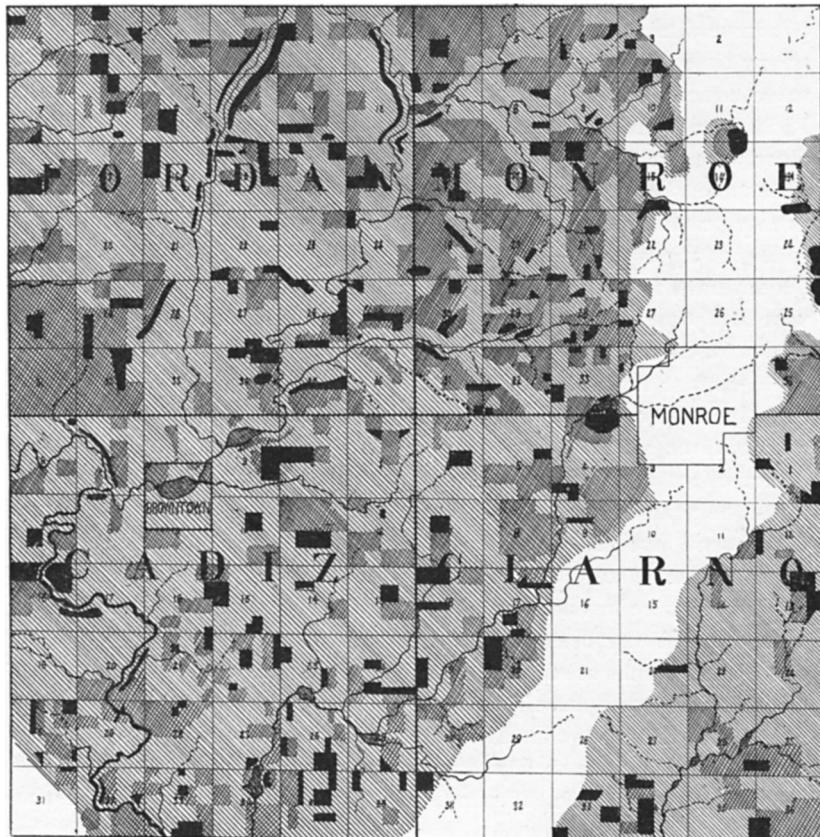
The accompanying map shows the native prairie and forest, the timber removed during the last fifteen or twenty years and that standing now, the water courses and former water courses now dry a large part of the year, and most of the former millponds. I have determined, by weighing them, the relative areas differentiated on the map, the result being : prairie 16.8 per cent., original forest 83.2 per cent., cleared fifteen to twenty years ago 55.9 per cent., cleared within fifteen to twenty years 27.3 per cent., timbered now (September 1902) 5.8 per cent.

"Fifteen to twenty years ago" is inexact, but it is usually impossible to tell exactly when a given tract was cleared, and any sharp line is therefore impracticable. The time indicated is that at which we became personally familiar with the country. It is also difficult, when the trees are gradually cut from an area, saw-logs first, cordwood a decade later, the young trees later still, or when some more or less abundant kinds are spared in the cutting, to decide when it ceases to be fitly mapped as timber. We have called any land timbered as long as the heavy shade is more continuous than the sod—a loose test, but as good as we knew.

The map and the figures based on it cannot show the change in the character of what timber remains. The forest was never homogeneous, but in general it was as dense as temperate deciduous forests often are. In general there was a considerable mesophytic undergrowth of thin leaved shrubs and herbs; more rarely the forest was dense enough to keep its floor relatively clear. In either case the ground was kept open and loose and the air over it cool and moist. In these four towns not a ten-acre grove of such forest is left. The surviving timber is pastured and the ground is tramped. The shade-loving, shade-making mesophytes disappear and grass gradually comes in. The trees become less vigorous and the grass more so. No axe is now needed. The grass-covered ground with scant shade is harder and smoother than the old forest soil, and dries very much more rapidly.

The vanishing percentum of surviving forest is thus practically even less than it appears.

From the settlement of the country until at least 1887 practically no creeks went dry, though there was a noticeable lowering. Since that time, according to the map, the water courses that are dry during



MAP OF PART OF GREEN COUNTY, WIS.

LEGEND:

	Original forest.
	Timber twenty years ago.
	Timber in September 1902.
	Flowing creeks.
	Creeks which have gone dry.

the entire summers or longer amount to $29\frac{1}{2}$ miles in Monroe, $10\frac{3}{4}$ miles in Jordon, $7\frac{1}{2}$ miles in Cadiz, and $17\frac{3}{4}$ miles in Clarno, a total

of $65\frac{1}{2}$ miles. This falls short of the real fact, because in Jordon and Cadiz, in the absence of certainty about some former creeks, we have omitted them; and because in exceedingly dry times the water has disappeared further than we represent, and these are the crucial times.

With the drying up of their head waters, the flow of the creeks has of course diminished everywhere. There are no measurements of flow at any time in the past, and, having nothing to compare with, we have made none. The millponds show the state of affairs most graphically. Rich, Honey, and Skinner Creeks each ran several mills; altogether there were twelve of these. All have been discontinued or equipped with steam power. On each creek there were running by water power twenty years ago at least two mills. The occasion for saw and grist mills is largely gone—reason enough why some of them are absent; but several now use steam. One mill near the mouth of Skinner Creek uses both water and steam. Where most of these mills stood less water runs now than used to be wasted.

A change in the forest covering of a region might indirectly affect the stream flow, through an effect on the total rainfall or its seasonal distribution; we have no evidence that this occurs. And the more direct effect in changing the structure and exposure of the ground might be years in making itself fully seen. Still, because of the length of the time involved, and because the deforestation had been relatively slow for some time preceding twenty years ago, we conclude that the creek flow there was adjusted to the forest area and condition; likewise, there having been no considerable change within five years, the timber and creeks seem to be in equilibrium now. If this be so, and assuming still that these four towns fairly represent the general region near about them, we can conclude that 27 per cent. of forest will nearly enough conserve the surface flow of water in country originally 83 per cent. forest so that the difference does not appear in any considerable loss of springs or drying up of creeks; but that if this forest be further reduced to 6 per cent., many creeks dry up and the flow of water in those remaining is reduced to probably about one-third.

About the rainfall in Monroe nothing exact is known, and if we had data, their relation to the deforestation would be very doubtful. While the loss of flowing water is a very local function of deforestation, the rainfall, if it be a clear function, is not localized at all. And the variation in different seasons and localities is so great that very extensive data in space and in years, as to both rainfall and the timbered

area, would be needed to make conclusions of any value. From the Weather Bureau reports at our disposal from stations from Milwaukee to Dubuque, some of them going back to 1871, it does not appear that there has been any significant change. The last decade includes dry years and wet years, dry and wet summers.

The influence of deforestation on the character of the flora is another interesting subject. While the relative representation of different components of the flora has of course changed profoundly, remarkably few plants have as yet become extinct. No tree has certainly disappeared except the juniper, which had a single locality and has not been seen within thirty years. We have the only local herbaria of any size, that of Herbert E. Copeland dating from the early seventies, and our own, mostly about seventeen years later. The only plants whose disappearance in that interval is highly probable are *Camassia Fraseri* and *Polygonia pendula*. In the last fifteen years *Cypripedium spectabile*, *Gaultheria procumbens*, *Phegopteris Dryopteris*, and possibly as many more plants all strictly local, seem to have been killed out. On rare rough hillsides and in gulches where the timber is relatively native, and in fence corners, in brush, or around stumps, the old flora persists. It is a most instructive lesson in the survival of what exists that above thirteen-fourteenths of the native habitat has been altogether changed in character, and the other one-fourteenth decidedly modified, without the extinction of a single common forest herb, shrub, or tree.—F. A. SHRINER and E. B. COPELAND, *Monroe, Wis.*

THE EFFECTS OF EXTERNAL AGENTS ON THE PRODUCTION OF ROOT HAIRS.

PRELIMINARY NOTICE.

DURING an endeavor to find the causes for the production of root hairs, results were obtained, which, though incomplete, may be of sufficient interest to warrant publication.

Seedlings of *Zea mais*, *Helianthus annuus*, *Lupinus albus*, *Avena sativa*, *Triticum vulgare*, *Vicia sativa*, *Cucurbita Pepo*, *Raphanus sativus*, *Brassica alba*, and *Cannabis sativa*, grown in water, showed a tendency not to develop typical water roots at once, but produced a longer or shorter zone of hairs, passing, in some forms, into the smooth surface usually characteristic of water roots. Apparently this zone of hairs in sunflower, radish, and white mustard was not directly influenced by light or darkness.